UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/975,211	10/10/2001	Joseph M. DeSimone	5470-316	7807

20792 7590 09/25/2003

MYERS BIGEL SIBLEY & SAJOVEC
PO BOX 37428
RALEIGH, NC 27627

EXAMINER
BARRECA, NICOLE M

ART UNIT	PAPER NUMBER
1756	

DATE MAILED: 09/25/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/975,211	DESIMONE ET AL.	
	Examiner	Art Unit	
	Nicole M. Barreca	1756	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *03 July 2003* .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-67* is/are pending in the application.

4a) Of the above claim(s) *34-67* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-33* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☒ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) *4,5* .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

1. Applicant's election with traverse of Group I, claims 1-33 in Paper No. 7 is acknowledged. The traversal is on the ground(s) that, as amended, all pending claims 1-67 now require carbon dioxide in both the deposition and developing steps. This is not found persuasive. While the applicant has amended non-elected claims 34-67 to additionally require carbon dioxide in the first composition, the examiner still maintains that restriction is proper. Group I, claims 1-33 and Group II, claims 34-67 are still related as subcombinations usable together, with invention I having separate utility a method for forming a resist image in a subtractive process or as a method for forming a resist image wherein a separate exposure apparatus is used.

The requirement is still deemed proper and is therefore made FINAL.

2. Claims 33-67 are withdrawn from further consideration pursuant to 37 CFR 1.142(b), as being drawn to a nonelected inventions, there being no allowable generic or linking claim. Applicant timely traversed the restriction (election) requirement in Paper No. 7.

Claim Rejections - 35 USC § 102

3. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for a patent.

4. Claims 1-4,13, 14, 16-20, 29-33 are rejected under 35 U.S.C. 102(a) as being anticipated by Sundararajan "Supercritical CO2 Processing for Submicron Imaging of Fluoropolymers".

5. Sundararajan teaches the use of supercritical CO2 as a solvent for lithographic processes such as spin coating and development steps. A polymer soluble in liquid CO2 is coated directly using liquid CO2, exposed and then developed using supercritical/liquid CO2. A variety of fluoro- and silicon containing polymers were previously tested in positive and negative photoresist schemes where the film became more soluble in SCF CO2 after exposure and vise versa. Polymers with acid cleavable tetrahydropyranyl group, such as THPMA, and SCF CO2 soluble perfluorinated methacrylate segments, such as 1H, 1H-perfluoro-n-butyl methacrylate or 1H, 1H-perfluorooctyl methacrylate were synthesized (p.B, C). Silicon wafers were first coated with an antireflective coating (intermediate layer) prior to the deposition of photoresist. Exposure was made at 193 nm (UV) (p.D). Chemical amplification as a photoacid generator (PAG) was used to affect the solubility difference (p.B, G).

Claim Rejections - 35 USC § 103

6. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

7. Claims 5 and 21 are rejected under 35 U.S.C. 103(a) as being unpatentable over Sundararajan as applied to claims 4 or 20 above, and further in view of DeSimone (US 5,739,223).

8. Sundararajan teaches depositing a fluoropolymeric (by using fluoroacrylate monomers) photosensitive coating using CO2, exposing the coating and developing or removing the coating with CO2. Sundararajan however does not disclose using the specific monomers listed in claims 4 and 21. DeSimone '223 teaches a process for making a fluoropolymer by solubilizing a fluoromonomer in a CO2 fluid. A preferred fluoromonomer for polymerization in a carbon dioxide fluid is 1, 1-dihy7doperfluorooctyl acrylate. See abstract and col.3, 10-col.4, 16. It would have been obvious to one of ordinary skill in the art to use 1,1-dihydoperfluorooctyl acrylate as the fluoromonomer in the process of Sundararajan because DeSimone teaches that this is a preferred monomer for polymerization in a CO2 fluid.

9. Claims 6-7 and 22-23 are rejected under 35 U.S.C. 103(a) as being unpatentable over Sundararajan as applied to claims 2 or 18 above, and further in view of Allen (5,665,527).

10. Sundararajan teaches depositing a polymeric photosensitive coating using CO2, exposing the coating and developing or removing the coating with CO2. Sundararajan dos not exemplify examples of Si-containing polymers, but does teaches that both Si and fluoro-polymers are known in the prior art to be soluble in CO2 and to be used as photoresists. Sundararajan is also silent on any specific silicon-containing polymer and does not disclose that the silicon-containing polymer is an alky, fluoroalkyl, or

chloroalkyl siloxane or mixtures thereof. Allen teaches a method for forming a resist developable in CO2 with improved resolution without environmental issues (col.1, 62-65). Examples of polymers soluble in CO2 critical development fluid includes fluorinated polymethylacrylates and polymers having alkylsiloxy (siloxane) substituents (col.2, 28-46, col.3, 1-10). It would have been obvious to one of ordinary skill in the art to use a polymer with an alkylsiloxane substituent instead of a fluoromethylmethacrylate substituent in the method of Sundararajan because Allen teaches that both polymers are soluble in CO2 development fluid and when used in photoresists produce improved images with less environmental issues.

11. Claims 8-9 and 24-25 are rejected under 35 U.S.C. 103(a) as being unpatentable over Sundararajan as applied to claims 2 or 18 above, and further in view of McCulloch (US 5,733,714).

12. Sundararajan teaches that the photoresist may be deposited over an intermediate layer such as an antireflective layer, but does not explicitly disclose that this layer is etched using the photoresist as a mask or that the etching is performed using oxygen, chlorine, fluorine or mixtures thereof. McCulloch teaches in the background that conventionally in the art after the resist has been exposed and developed, the (underlying) antireflective layer is then etched, typically with oxygen plasma, using the resist pattern (col.2, 1-5). It would have been obvious to one of ordinary skill in the art to etch the antireflective or intermediate layer in the method of Sundararajan using oxygen plasma and to use the resist pattern as an etch mask because McCulloch teaches that this is conventional in the art.

13. Claims 10, 15 and 18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Sundararajan as applied to claims 2 or 18 above, and further in view of Livesay (US 5,468,595).

14. The teachings of Sundararajan have been discussed above. Sundararajan teaches depositing a polymeric photosensitive coating using CO2, exposing the coating and developing or removing the coating with CO2. While Sundararajan teaches patterning the photoresist, the reference is silent on further processing steps and does not disclose depositing a metal or ionic material on the (exposed) substrate and then removing the resist coating (i.e. an additive lift-off process). Livesay teaches that an additive process, where material is deposited via evaporation, electroplating or ion implantation after the resist has been patterned, is known in the art. In such an additive or lift-off process metal is deposited after the resist is patterned and then the resist is stripped off, leaving metal in the windowed areas of the resist (col.1, 64-col.2, 2). It would have been obvious to one of ordinary skill in the art to deposited metal (or implant ions) on the substrate after the resist patterning and then remove the exposed coating portion from the substrate in the method of Sundararajan because Livesay teaches that this additive lift-off process is known in the art.

15. Claims 10-11, 15 and 26-27 are rejected under 35 U.S.C. 103(a) as being unpatentable over Sundararajan as applied to claims 2 or 18 above, and further in view of Takahashi (US 6,265129).

16. The teachings of Sundararajan have been discussed above. Sundararajan teaches depositing a polymeric photosensitive coating using CO2, exposing the coating

and developing or removing the coating with CO2. While Sundararajan teaches patterning the photoresist, the reference is silent on further processing steps and does not disclose depositing a metal or ionic material on the (exposed) substrate and then removing the resist coating (i.e. an additive lift-off process), or that this metal coating is Al, Cu, Au, Ti, Ta, W, Mo, Ag or alloys thereof. Takahashi teaches that conducting patterns and electrodes made up of metals such as Al, Cu and Ta are formed on semiconductor substrates by well known processes, such as the lift-off technique. In a typical lift-off technique metal is deposited on the entire substrate including the patterned resist, after which the resist is removed lifting-off the overlying metal but leaving the metal intact on the substrate as a conducting pattern (col.1, 21-35). It would have been obvious to one of ordinary skill in the art to deposit a metal, such as Al, Cu or Ta, on the substrate including the resist pattern and then remove the resist to leave a metal pattern, in the method of Sundararajan, because Takahashi teaches that this is a well known method for forming conducting patterns in the semiconductor art.

17. Claims 10, 12, 15, 26 and 28 are rejected under 35 U.S.C. 103(a) as being unpatentable over Sundararajan as applied to claims 2 or 18 above, and further in view of Leedy (US 3,858,304).

18. The teachings of Sundararajan have been discussed above. Sundararajan teaches depositing a polymeric photosensitive coating using CO2, exposing the coating and developing or removing the coating with CO2. While Sundararajan teaches patterning the photoresist the reference is silent on further processing steps and does not disclose depositing a metal or ionic material on the (exposed) substrate and then

removing the resist coating (i.e. an additive lift-off process), or that this ionic coating is B, P, Ar or combinations thereof. Leedy teaches that ion implantation processes are well known in the art and involve ionizing impurity atoms such as boron and phosphorus before accelerating these ions into the semiconductor substrate exposed by the resist or other masking material (col.3, 31-col.4, 10). It would have been obvious to one of ordinary skill in the art to deposit an ion, such as B or P, on the substrate exposed by the resist pattern, in the method of Sundararajan, because Leedy teaches that this is a well known method for ion implantations in the semiconductor art.

Conclusion

19. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Nicole M. Barreca whose telephone number is 703-308-7968. The examiner can normally be reached on Monday-Thursday (8:00 am-6: 30 pm).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Mark Huff can be reached on 703-308-2464. The fax phone number for the organization where this application or proceeding is assigned is (703) 872-9306.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0661.

Nicole Barreca
Patent Examiner
Art Unit 1756
9/15/03